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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Marine boundary layer over the subtropical southeast Pacific during VOCALS-REx – Part 1: Mean structure and diurnal cycle" *by* D. A. Rahn and R. D. Garreaud

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This paper provides an overview of the mean atmospheric circulation during VOCALS-Rex and examines the ability of a WRF simulation to replicate mean VOCALS-Rex conditions. An original contribution is a thorough analysis of the radiosondes. Main findings are an undersimulation of coastal MBL depth (also documented for other models in Wyant et al. 2009) that then explains a slower-than-observed speed of a diurnal gravity wave propagating normal to and away from the coastline, resulting in a model-observational diurnal cycle discrepancy at 75W. This discrepancy appears to be gone by 85W, perhaps because the model BL depths match observed values more closely

further offshore. This interpretation is arguably more nuanced than that supporting the conclusion drawn in Wyant et al. 2009, that most models do show a phase speed similar to observations despite typically too-shallow MBLs. I enjoyed reading the paper and particularly appreciated the radiosonde analyses. My comments are minor.

comments:

Were there interesting differences, lessons learned, between this current work and the work done using the same model setup (I believe) for the Prevoca assessment?

The authors selected Oct. 30-Nov. 3 for their diurnal cycle analysis at 75W, and find a clear diurnal cycle in their composite. I personally found a stronger, more typical, diurnal cycle at this location during Nov. 12 -14, than Oct. 30-Nov.3, with Oct. 31 perhaps best typifying the boundary layer diurnal cycle in depth, lwp, and wvp (plots available upon request). This seems consistent with the authors' Fig. 10c. Have the authors examined Nov. 12-14 at all ? I doubt the results will be that different, but the additional days may contribute towards an even clearer observed mean diurnal signature and strengthen the model-observational discrepancy analysis.

minor/more specific comments:

abstract: currently no mention made of WRF performance (on MBL depth; upsidence wave), which I presume is an oversight. It may also be worth highlighting the distinct diurnal cycle at Iquique relative to Arica in the abstract, given that Iquique was one base of operations during vocals-rex.

introduction, first paragraph: This paragraph seems hastily written. The outstanding attributes of the SEP cloud deck are not all related to the presence of the Andes, as is implied in one sentence. Some of the citations don't seem appropriate. e.g., Bony and Dufresne, 2005 concerns itself more with low cloud predictions than current climate; Tomlinson et al. 2007 focuses on the clean offshore air and is careful to not attribute high aerosol concs to the copper smelters. Painemal and Zuidema 2009 also do not

attribute high coastal aerosol conc.s to the smelters. Wood et al. 2008 should be Wood et al. 2009.

section 3.2 & 3.3, alongshore observations: I am not completely comfortable with the claim that mbl depths are 'nearly level' north of 25 S. The reported mbl values are similar to those from the satellite climatology shown in Zuidema et al. 2009 fig. 9, but the latter shows a shallower MBL depth at 25S than 18S (1 km vs 1.2 km). A comparison of Figs. 4 and 5 also suggests to me that mean MBL depths were higher at Arica than Paposo. I wonder if the authors are being overly influenced by the 3 radiosonde locations that were within 4 latitude degrees of each other.

section 4, diurnal cycle: It would ease reader comprehension if local solar time was used more. I found myself consistently trying to convert utc to local solar time in my head while reading this section. Certainly coastal references can easily make use of local solar time.

4.2 observations: my understanding from other work is that the upsidence wave helps to reinforce the radiatively-forced diurnal cycle at 85W (e.g., Caldwell et al. 2005 I believe). If I understand the text correctly here, the authors find the expected diurnal cycle in the observations and in the simulations, but aren't confident the upsidence wave is playing a role in exaggerating the radiatively-driven diurnal cycle, because synoptic influences are weakening the diurnal cycle for the chosen time period. It's my sense that EPIC was lucky to experience a strong diurnal cycle at this location (from, for example, O'Dell's satellite LWP dataset), which seems consistent with the weaker statements of the current paper.

Summary, last point on the model-observation discrepancy. Worth mentioning here is that the discrepancy is apparent at 75W but not 85W (if I am interpreting that correctly).

Figures: some of these are difficult to read (Fig. 5,6,8 in particular, Fig. 12) while others would benefit from the use of local solar time (utc- longtitude/15.) rather than UTC. Fig. 6: caption is a little vague. make clear in caption that theta, u and v are

from radiosondes exclusively. Fig. 7 : red is down, blue is up? mention in caption. The scale is very difficult to read. Fig. 9: what do the horizontal lines on panel a indicate? Fig. 11: would recommend using local solar time rather than utc on x-axis. Fig.12: x-, y-axis is impossible to read. again some indication of local time on the x-axis would be helpful - either just go with local time, or use vertical bars to indicate sunrise/sunset.

Table 1: It would be helpful to see the latitudes indicated of the coastal stations next to their name, and have the local time associated with 0 and 12 UTC included in the caption.

references: update Wyant et al.,; Painemal and Zuidema; Wood et al 08 should be 09.

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